

# VIII THE EYE

## THE DOCTORS FRIEDENWALD



Ophthalmologic progress in the United States of America is indebted to contributions from three generations of the Friedenwald family of Baltimore. The first Friedenwald in Baltimore arrived penniless from Altenbuseck, Germany, in 1831, looking for opportunity. He became a well-known philanthropist before his death in 1893, and the father, grandfather, and great-grandfather of a scholar.

Aaron Friedenwald was born in Baltimore in 1836 and began medicine at age 21 under the preceptorship of Nathan R. Smith. Friedenwald graduated from the College of Physicians and Surgeons in Baltimore in 1860 at age 24 and went abroad for two years, where he studied in Berlin under Von Graefe, whose assistants were Liebreich and Schweiger, and in Vienna with Arlt, whose operative skill was unchallenged. When he

returned to Baltimore, he combined a general practice with ophthalmology, for he was the only practicing "eye doctor" in the city, George Frick having retired from practice. In 1873 he was elected professor of ophthalmology at the College of Physicians and Surgeons, which position he held until his death in 1902. A major figure in raising the standards of medical education, Friedenwald proposed the creation of the present Association of American Medical Colleges in 1890. His papers and addresses covered a range of ophthalmologic diseases, including "Opticneuritis," "Optic Nerve Atrophy," "Ocular Paralysis," "Uraemic Amaurosis," and "The Relation of the Eye to Spinal Diseases." He also wrote on "The History of Jewish Physicians" in 1897. His gentle manners were a medicine in themselves. An account of the *Life, Letters and Addresses of Aaron Friedenwald* was prepared by his eldest son, Harry, in 1906.

Harry Friedenwald was born in Baltimore in 1864, graduated from Johns Hopkins University in 1884 and the College of Physicians and Surgeons in

Baltimore in 1886. After a year in residency at City Hospital in Baltimore, he went abroad. His chief influences were Hirschberg in Berlin, whose *History of Ophthalmology* is a classic, and Politzer, the otologist in Vienna. No doubt Friedenwald's interest in medical history was stimulated in Berlin. He returned to Baltimore after three years and entered practice in ophthalmology and otology. He succeeded his father in 1902 as professor of ophthalmology at the College of Physicians and Surgeons, which position he held until 1929, when he became emeritus professor. He wrote many articles, about 115 in ophthalmology, 20 in otology, and 50 in history. His finest medical contributions concerned ocular manifestations of general diseases, such as arteriosclerosis, systemic hypertension, and diabetes mellitus. The high point of his professional career was perhaps in 1930, when he delivered the Doyne Memorial Lecture on "Pathologic Changes in the Retinal Blood Vessels in Arteriosclerosis and Hypertension" before the Oxford Ophthalmologic Society. His interest in history was slow to mature. His first historical paper was written when he was age 34, after he had authored 50 scientific papers. His major interest in history culminated in a book, *The Jews and Medicine*, published in 1944. He was a long-time friend of William H. Welch and a bibliophile. His library of Jewish works were bequeathed to the Hebrew University in Jerusalem, Israel, at his death in 1950.

Jonas S. Friedenwald was born in Baltimore in 1897 and graduated with a B.A. in 1916 and M.D. in 1920 from Johns Hopkins University. While working with Frederick Verhoeff in pathology, he obtained an M.A. from Harvard University in 1922. After a year's preceptorship under de Schweinitz at the University of Pennsylvania, he returned to Baltimore at age 26 to begin practice with his father. As Alan C. Woods pointed out,

*It is notable that he had no formal training in any of the special ophthalmologic hospitals of that era. . . . But when one considers that Jonas had been trained in ophthalmology in his home from his first days in medicine, that he undoubtedly learned more in one year than the average student could assimilate in three, that he utilized to the limit every educational facility available to him, this training was more than enough.*  
(Woods, 1956)

The family fortunes had been established, affording this Friedenwald an opportunity to practice before noon and research after noon. In 1923 he was appointed instructor in ophthalmic pathology at Johns Hopkins University and directed much research conducted at the Wilmer Institute of Ophthalmology, which opened in 1926. He was appointed associate professor of ophthalmology at Hopkins in 1931, which position he held until his death in 1955. Attaining greater fame than his father or grandfather, he is considered the eminent ophthalmologic scientist of his generation in the United States. Many of his 140 papers concerned the formation and dynamics of intraocular fluid. He designed an ophthalmoscope in 1928, developed by American Optical Company. His book, *Pathology of the Eye*, appeared in 1929 when he was age 32, the same year as his classic paper on "The Pathogenesis of Acute Glaucoma," which established the role of edema of the ciliary body. His book, *Atlas of Ophthalmic Pathology*, appeared in 1952. He loved physics and mathematics and employed them in work. An avocation was painting, about which he wrote in a fascinating essay, "Knowledge of Space Perception and the Portrayal of Depth in Painting."

—CHARLES STEWART ROBERTS

**REFERENCES**

- Friedenwald H. Life, letters and addresses of Aaron Friedenwald. Baltimore: Lord Baltimore Press, 1906.
- Friedenwald H. The Jews and medicine. Baltimore: The Johns Hopkins Press, 1944.
- Friedenwald J. Pathology of the eye. New York: Macmillan, 1929.
- Patz A. Jonas S. Friedenwald, man of science. Invest Ophthalmol Vis Sci 1980;19:1139-49.
- Temkin O. Harry Friedenwald. Bull Hist Med 1951;25:185-90.
- Woods AC. Jonas S. Friedenwald: in memoriam. Bull Johns Hopkins Hosp 1956;99:23-28.



## History

The examiner's ability to help a patient clarify or elaborate on an ocular symptom and the examiner's knowledge of the significance of some common ocular symptoms will often facilitate correct diagnosis on the basis of history alone.

When a patient complains of *eye pain* (Chapter 112), it is essential to describe the ocular discomfort clearly. The examiner must differentiate between itching, tearing, burning, foreign body sensation, photophobia, deep pain, pain on eye movement, or tenderness to touch. Frequently, the patient will have more than one type of symptom and the examiner must ask, "Which part of your eye problem is most disturbing to you?"

Itching of the lids and conjunctiva is a fairly specific symptom that may be associated with surface allergy, hay fever, or other forms of Type I immediate hypersensitivity. Burning is an external ocular symptom as occurs commonly in conjunctivitis. Foreign body sensation is more specific and occurs when there is a break in the corneal epithelium, exposing sensitive corneal nerves to the opening and closing of the eyelids (e.g., corneal abrasion).

In contrast, photophobia, painful spasm on exposure to bright light, often accompanies intraocular inflammation and therefore has to be separated from more mundane complaints, such as burning. By asking the patient whether there is a "headache" around the eye that is worse in bright light will often clarify the complaint as being photophobia. Deep pain or discomfort on eye movements is a rather specific symptom associated with retrobulbar neuritis and is due to the proximity of the extraocular muscles to the inflamed optic nerve. Tenderness to touch is an uncommon ophthalmic symptom that may be seen in episcleritis and scleritis.

Acute decrease in visual acuity (Chapter 111) should be an alarming symptom to both the patient and the examiner. A few simple questions will often help in the diagnostic thought process. Acute loss of vision is usually in one eye only. In the older patient, common causes include retinal vascular disease and acute ischemic optic neuropathy, the latter sometimes associated with temporal arteritis. In the younger patient, unilateral central visual loss may be associated with retrobulbar neuritis with deep pain on eye movements supporting this diagnosis. Visual loss associated with flashes of light (photopsia) and floaters should make one think of retinal detachment. A diabetic with sudden unilateral visual loss often has a vitreous hemorrhage due to proliferative retinopathy.

Reversible central visual loss is seen in amaurosis fugax and occasionally in migraine. In the former, visual loss is nearly complete in one eye and is signaled by the sensation of drawing down a curtain with restoration of acuity always occurring within several minutes. Migraine may start with central scintillation and distortion spreading to the periphery of visual and often followed by a typical migraine headache.

Gradually occurring, painless loss of vision is seen commonly with cataracts, advanced glaucoma, and retinopathy, especially degenerative retinopathy in the elderly.

Diplopia, or double vision (Chapter 113), is a highly significant symptom frequently signifying the presence of neurologic disease and must be separated from symptoms that do not represent diplopia. One must establish that the patient truly means that they have double vision rather than just blurred vision. One may ask, "Do things seem very blurry, or when you look across the room, do you really see two of everything?" If the answer to this question is yes, the next step is to eliminate the rare possibility of monocular diplopia. Simply tell the patient to cover one eye or the other and ask whether the double vision goes away. If occlusion of one eye relieves double vision, then one has established true diplopia.

One then asks whether the two images seen are side by side or vertically displaced. By far, the most common answer is horizontal displacement. In an acute setting, this usually implies dysfunction of either a medial rectus muscle (cranial nerve III) or lateral rectus muscle (cranial nerve VI). If double vision is worse when looking at distant objects than at nearby objects, difficulty in divergence is suggested making a sixth nerve paresis more likely. Conversely, greater horizontal diplopia at near than at distance represents difficulty in convergence, with a third nerve paresis (medial rectus) more likely. Finally, variability in diplopia increasing with fatigue toward the end of the day is highly suggestive of myasthenia gravis.

Other visual disturbances may be reported. Blurred vision is a frequent complaint of diabetics with recent episodes of elevation of blood glucose caused by reversible osmotic swelling of the crystalline lens. "Floaters" are extremely common and represent minute opacities suspended in the posterior aspect of the vitreous gel. Photopsia, the visual sensation of seeing tiny flashes of light, is usually caused by mechanical traction on the retina and is often seen with retinal detachment. Light scintillation and visual disturbance and metamorphopsia, or alteration of form, may precede migrainous headaches, although metamorphopsia alone may be associated with swelling or deformation of the retina.

## Ophthalmic Examination

Table 110.1 lists the equipment used for examining the eye.

General inspection of the eyes and adnexa is discussed in Chapter 114. It is important to get an overview of the patient. This is especially true if the patient has external ocular complaints. Specifically, if the eyes or eyelids are inflamed, the general pattern of inflammation should be described. Pale, boggy swelling of all four eyelids is certainly seen in classic allergic reactions, while eczematous changes of the lower eyelids are associated with hypersensitivity to topical medications. If external inflammation is present, by all means palpate for preauricular and submandibular nodes,

**Table 110.1**  
Instruments Used in the Eye Examination

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Ophthalmoscope
Penlight
Near card for visual acuity test
Mydriatic in selected patients

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as these enlarge in viral conjunctivitis and Parinaud's oculoglandular syndrome. Finally, is one eye more prominent or proptotic than the other?

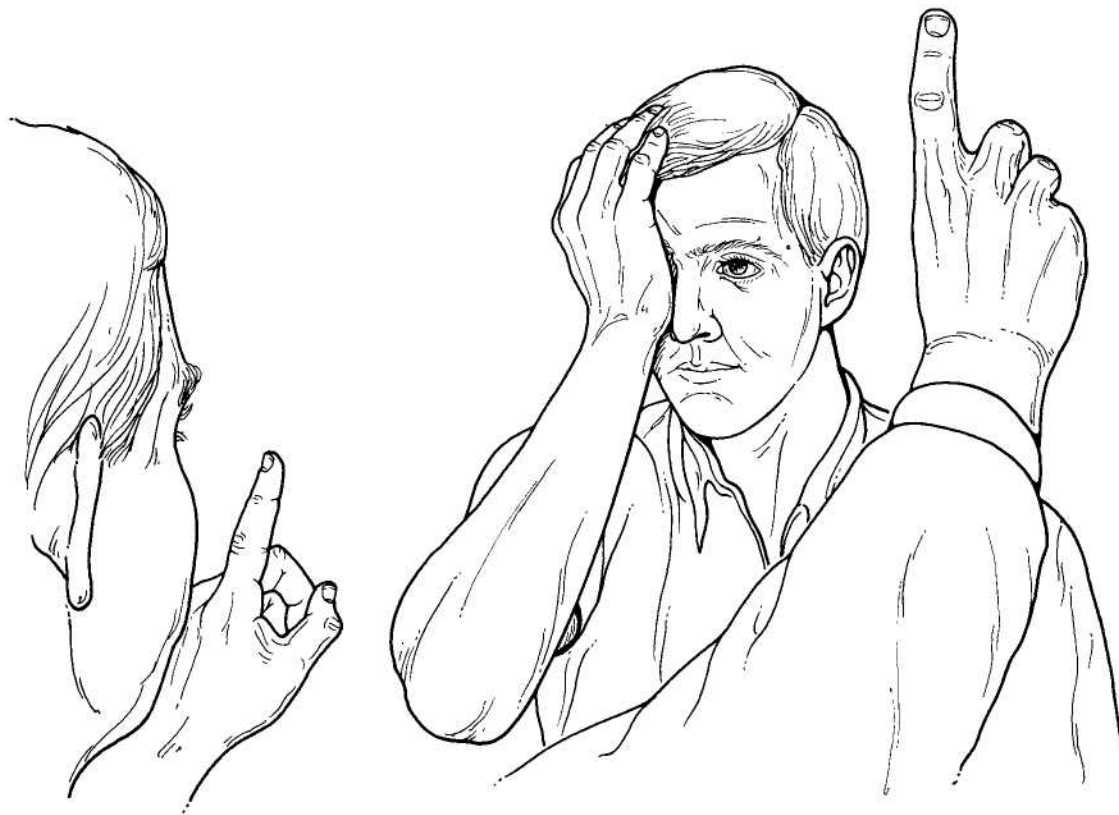
*Central visual acuity* (Chapter 115) is the "vital sign" of the ophthalmic examination. The documentation of good visual acuity in an eye establishes the presence of a near normal refraction, clear ocular media, good retinal function, and intact afferent neuropathways and cortical functioning. The use of an eye chart at 20 feet (6 m) is certainly not appropriate for all clinical settings. Even at the bedside, however, a hand-held visual acuity card or small newsprint can be used to estimate the patient's visual acuity. It is essential when measuring visual acuity at near distances in patients older than 40 years of age that reading glasses, if customarily used, should be worn.

Testing the *visual fields* (Chapter 116) by confrontation can detect conditions affecting the optic chiasm, tracts, and visual cortex. The patient is instructed to cover one eye and

look directly into the examiner's eye (Figure 110.1). Simultaneously, the examiner can make small hand movements in the periphery of his or her own visual field, telling the patient to say "now" with the first awareness of any movement. With confrontation testing, one is concerned with and most likely to find dense visual field loss as seen in cortical and chiasmal lesions.

Proper alignment of the eyes and *extraocular motility* can be easily ascertained with brief examination. A penlight, held 18 inches (45 cm) from the patient's eyes, is aimed directly into the pupils with the patient looking at the light (Figure 110.2). The resultant light reflex should be in the same relative position on both corneas. The examiner then uses his or her hand to immobilize the patient's head and tells the patient to follow the penlight. The examiner then moves the penlight to both horizontal extremes as well as upward and downward, observing for appropriate movement of the patient's eyes. The corneal reflex should remain symmetrical in both eyes as they move, and the patient should continue to see one light throughout the examination.

To examine the *pupils*, the level of the ambient light should be reduced and, to relax accommodation, the patient should be directed to look at a distant object. Using a penlight directed from below, just barely illuminating the pupils, one inspects for symmetry in pupillary size. The patient continues to view a distant object, and each pupil is tested separately for constriction in response to bright light.



**Figure 110.1**  
Examination of the visual fields by confrontation. With the examiner approximately 18 inches (45 cm) from the patient, the patient's fellow eye is covered; the examiner makes small finger movements, asking the patient for an immediate "now" when movement is detected. The examiner can close one eye and use his or her own visual field as a reference.





**Figure 110.2**

The corneal light reflex. By directly shining a penlight into the patient's pupils from a distance of 18 inches (45 cm) and instructing the patient to look directly at the light, a minified reflection of the penlight can be seen on each cornea. If the eyes are properly aligned, the corneal "light reflex" should be located centrally on each cornea. Displacement of the light reflex in one eye while the patient is looking at the light is suggestive of faulty ocular alignment (e.g., esotropia, exotropia, cranial nerve paresis).

The penlight is then quickly moved from one pupil to the other, shining light directly into each eye (the "swinging penlight test" to elicit afferent pupillary defect). In this test, one is specifically looking for a pupil that dilates as the light is first directed toward it, demonstrating greater consensual than direct response. The afferent pupillary defect is also known as a Marcus Gunn pupil.

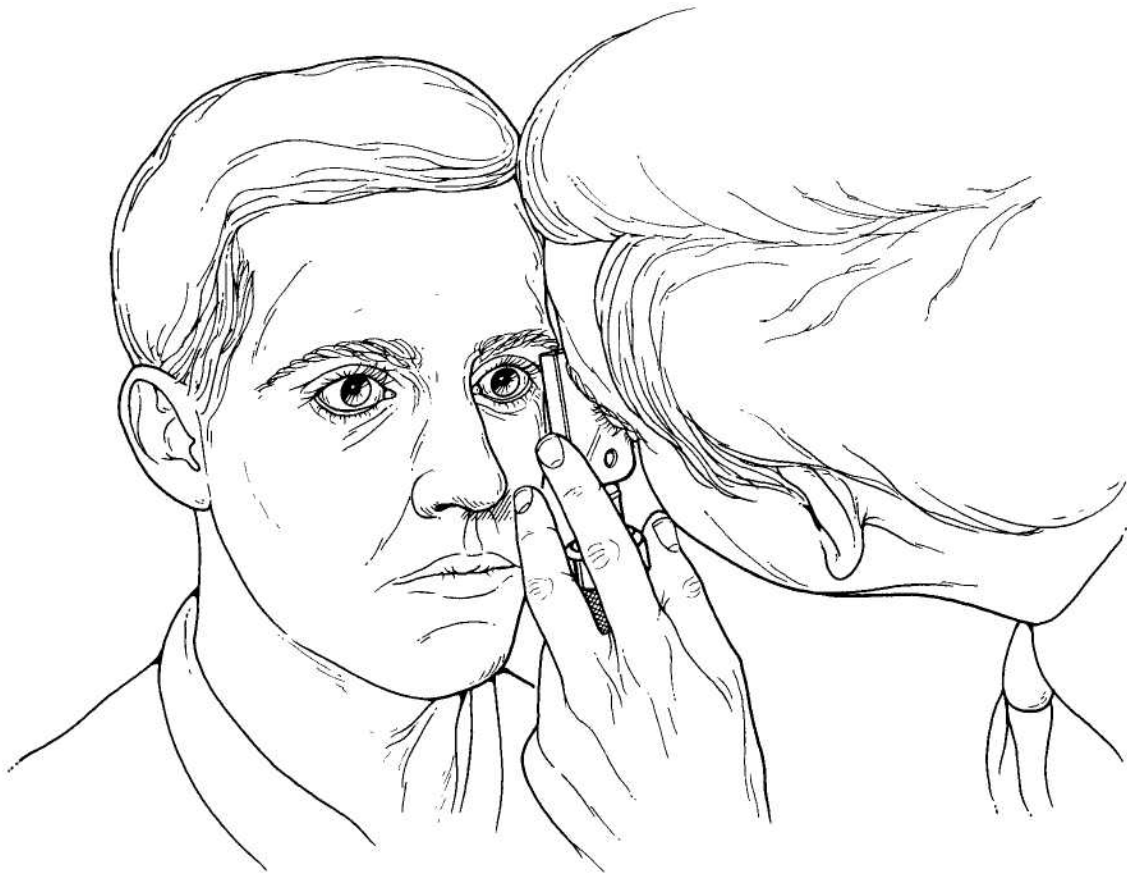
If any discrepancy of more than 1 mm in pupillary size is found, the pupils are measured in both bright and reduced ambient light. Differences in pupillary size (anisocoria) tend to be physiologic and not pathologic if such differences are only 1 to 2 mm and remain the same in differing levels of ambient light.

A penlight is used examine the *anterior segment* of the eye, namely, the cornea, anterior chamber, iris, and pupil. The cornea is generally crystal clear, and opacities without inflammation usually represent old scars. The anterior segment should be appreciated as a three-dimensional structure, especially when viewed from the side. The cornea has a domed convexity with the iris and pupil in a single plane several millimeters posterior to the apex of the cornea. In most patients the three-dimensionality of the anterior segment can be easily observed.

A shallow anterior chamber (i.e., predisposition to acute angle closure glaucoma) should be suspected when the iris

and pupil appear as if they were painted on the back of the cornea. This loss of three-dimensionality often identifies the shallow anterior chamber, and a patient with such a configuration should not be dilated pharmacologically. Irregularity in pupillary shape, usually the result of previous inflammation or surgery, should be described.

For the *fundus examination* (Chapter 117), the patient is directed to look straight ahead at a distant object. The ophthalmoscope is turned to its brightest illumination, the smaller aperture used if the patient is undilated, and the patient is approached from 15 degrees temporally with the ophthalmoscope set on zero (Figure 110.3). It is helpful to tell the patient, "Even though I will be right in front of you, please make believe that you can see through me and continue looking at the object at the end of the room." The examiner then puts the ophthalmoscope to his or her right eye to examine the patient's right eye, approaching from 15 degrees temporally. As the ophthalmoscope approaches the patient's eye, one observes for blood vessels or the optic disk to come into view. The optimal distance between the patient's cornea and the ophthalmoscope is 2.5 cm or less and is best maintained by wrapping one's forefinger around the ophthalmoscope and resting the finger and ophthalmoscope on the patient's cheek to stabilize the viewing arrangement. As soon as a retinal blood vessel or the disk



**Figure 110.3**

Use of the ophthalmoscope. The patient's right eye is approached from 15 degrees temporally with the examiner setting the ophthalmoscope at zero, holding it in the right hand, and observing with the right eye. A red reflex is observed and the ophthalmoscope is slowly brought to approximately 2.5 cm from the patient's right eye with the viewing arrangement stabilized by resting the right index finger on the patient's cheek.

When the optic disk or a retinal vessel is seen, the focusing wheel of the ophthalmoscope is empirically turned until the clearest view is obtained.

comes into view, the focusing wheel of the ophthalmoscope is moved one way or the other to achieve the clearest image. If a retinal vessel is found first, one searches for a vascular bifurcation "showing the way" to the optic disk (i.e., vessels bifurcate as they course away from the disk toward the retinal periphery).

With the disk in view, one inspects from the center outward. First, identify the borders of the optic cup and the proportion of its horizontal diameter to the total diameter of the disk (cup/disk ratio). The substance of the disk is then examined to be sure that it is pink and healthy and that its margins are clear and sharp.

Subtle undulation in the caliber and the light reflex of the retinal venules adjacent to the optic disk represents venous pulsation, which is normal, occurs with the heart-beat, and should be recorded if present. The venules are somewhat darker and larger in caliber than the arterioles.

The normal arteriole to venule diameter ratio is 2:3. Decreases in this ratio are seen in arteriosclerosis as associated with hypertension.

The posterior pole of the retina is then examined systematically. First, one follows the superonasal arteriole and venule leaving the disk as far in the periphery as possible. This is repeated with the inferonasal vessels, the inferotemporal vessels, and then the superotemporal vessels. Finally, the fovea is visualized by directing attention several disk diameters temporal to the disk and very slightly inferiorly. This maneuver is saved for last because this is the most sensitive portion of the retina to bright light. The foveal reflex will be seen and often has a slightly yellowish surrounding area (macula lutea).

The identical procedure is then carried out on the patient's left eye, using the left eye for viewing.